CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S0501

Project Title
The Use of Exothermic Reactions of Alkaline Battery Materials as a Precursor to Predicting Battery Performance

Abstract

Objectives/Goals
Alkaline batteries consist of a strict combination of different elements in order to produce energy; however the quantity of different ratios or combinations possible is near unlimited. Instead of trying to combine the numerous ratios or combinations possible, I wanted to find a screening method that could predict battery performance. Since I could not test every ratio in a battery form, I looked at the base materials# exothermic properties. The ratio with the hottest reaction would be made into a battery and compared to a battery based on a common alkaline battery.

Methods/Materials
1. Calculate the different ratios for tests 1-9, 2. Measure out each amount of Zn, MnO2, and KOH according to the ratio and test all of them, 3. Find the ratio with the hottest temp, 4. Take that ratio and calculate the anode and cathode sides, 5. Do this again for the ratios of the Duracell Battery (High MnO2), 6. Make a single cell alkaline battery for both the high Zn and high MnO2 mixtures, 7. Connect the batteries through a circuit, 8. Record the voltage over time, 9. Graph the results to see which battery had the highest capacity.
1. Zn, 2. MnO2, 3. Carbon, 4. Resistor, 5. Multimeters, 6. Thermometer, 7. Calorimeter, 8. Aluminum/ copper/ nickel mesh, 9. PPE, 10. Scale, 11. Beakers and Utensils, 12. KOH

Results
I found that the ratio from the hottest exothermic reaction would make the most efficient battery. The highest temperature occurred during test #7 at 88.2°. The ratio from this equation was taken and made into a battery and was compared to a battery formed from ratios derived from a Duracell alkaline battery. The Zn battery put out 244% more power than the high MnO2 battery or Duracell battery.

Conclusions/Discussion
Yes, it is possible to enhance the performance and power output of an alkaline battery by changing the ratio of anode and cathode materials to exceed that of a commercial or common alkaline battery. Therefore, there is a correlation between exothermic reactions and the chemical energy in a battery. This experiment demonstrated that the mixture of Zn, MnO2, and KOH that had the highest exothermic property produced more energy than that of a mixture with a low exothermic reaction.

Summary Statement
This project explores the exothermic properties of alkaline battery materials and their correlation to power production in battery form.

Help Received
I received help from the Lithchem Energy Lab including Dr. Novis Smith as well as help from my parents who helped me decorate the board and make the batteries.